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## A NEW SPECIES OF ARMIGERES FROM SABAH, BORNEO

(DIPTERA: CULICIDAE)<sup>1, 2</sup>

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ABSTRACT—A new species, *Armigeres* (*Armigeres*) **kinabaluensis** is described from Sabah, East Malaysia. The adult female and male, pupa and larva are described in detail. Illustrations of the male genitalia, pupa and larva are provided. *Armigeres kinabaluensis* is a mountain species and breeds mostly in tree holes, and artificial containers.

During a recent mosquito survey in Sabah, East Malaysia, a new species of *Armigeres* was discovered on Mount Kinabalu and Tambunan on the Crocker Range. Reference to this species and a drawing of the male genitalia was made by Baisas (1935), from a single specimen sent to him from Mount Kinabalu, at about 4,000 feet elevation. As the specimen was in poor condition, Baisas did not

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name nor describe it. Several collections of this species were obtained during our survey so that a fairly large series of adults, immature stages and associated skins are now available for description.

The terminology used in describing the adult and pupal stage is from a recent series "A Mosquito Taxonomic Glossary" by Knight and Laffoon (1970-71), except for the larval stage where Balkin's (1962) terminology is used. In the description of the immature stages, the following system is used for seta branching: if only one numeral is given in parentheses following the seta number, it represents the only number of branches encountered in the sample; if two sets of figures are given, the first represents the mean number of branches rounded out to the nearest whole number and the second, the range encountered in the sample. The chaetotaxy of the immature stages was determined from a sample of ten individuals.

***Armigeres (Armigeres) kinabaluensis*, n. sp.**

FEMALE.—Wing, 4.29 mm. Proboscis, 2.39 mm. Fore-femur, 2.47 mm. Abdomen: 3.97 mm. Large in size.

Head: Eyes nearly meeting above pedicel of antenna. Pale scales of head white to dingy white; dark scales brown-black in colour with bluish lustre at certain angles. Narrow band of pale scales along ocular line, broadening ventrally in postgenal area. Vertex covered with flat, broad, dark scales except for small central patch of pale scales. Frontal and ocular setae present. Erect scales all dark and forked, restricted to occiput region of head. Side of head mostly white scaled with dark scales on posterior aspect. Clypeus with dark integument; bare. Proboscis long, laterally compressed in apical half, covered over uniformly by dark scales. Pedicel of antenna with dark integument, covered with small white scales except for dorsal, outer sector, which is bare. Flagellum of antenna pilose; approximately 2.41 mm. long.

Thorax: Integument brown to dark brown. Scutum densely covered with long, narrow, curved, brown-black scales, having metallic lustre. A narrow border of narrow, curved, white scales extending from anterior promontory and ending over root of wings. Acrostichal, dorsocentral and scutal fossal setae absent. One to 4 prescutellar, and a row of supra-alar setae present. Scutellum covered with small, flat, dark scales, in three distinct lobes, with a few white scales at the tip of each lobe. Setae arising in three groups. Mesopostnotum bare, integument light brown. Anteprenotal lobes of normal size, covered by small, white scales on sides and front; top with small, dark scales and row of setae. Postpronotum with brown, dingy-white scales on lower posterior half; a few narrow pale scales may be present above these; anterior, dorsal aspect with narrow, dark scales; row of 4-7 setae along posterior border. Prespiracular setae absent. Postspiracular area with patch of small white scales. Propleuron with white scales. Paratergite with a line of white scales. Mesepisternum with 2 large patches of white scales; a row of setae along the posterior border and a dense group in the prealar region. Mesepimeron with a large patch of white scales on anterior upper portion; a single lower and a dense patch of upper mesepimeral setae present. Setae and scales absent on mesomeron and metepi-

sternum. Base of mesomeron in line with or slightly higher than base of hindcoxa.

Leg: Fore coxa covered by white scales with a patch of dark scales in the centre; mid and hind coxae with a patch of white scales on anterior side. Trochanter of all legs with pale scales. Fore and mid femur with a band of white scales on ventral side to knee; hind femur with band of white scales on outer aspect, narrows towards knee. Rest of legs covered with dark scales. Unguis of fore leg equal, each with a tooth; unguis of mid and hind legs smaller than that of fore leg, equal and without a tooth.

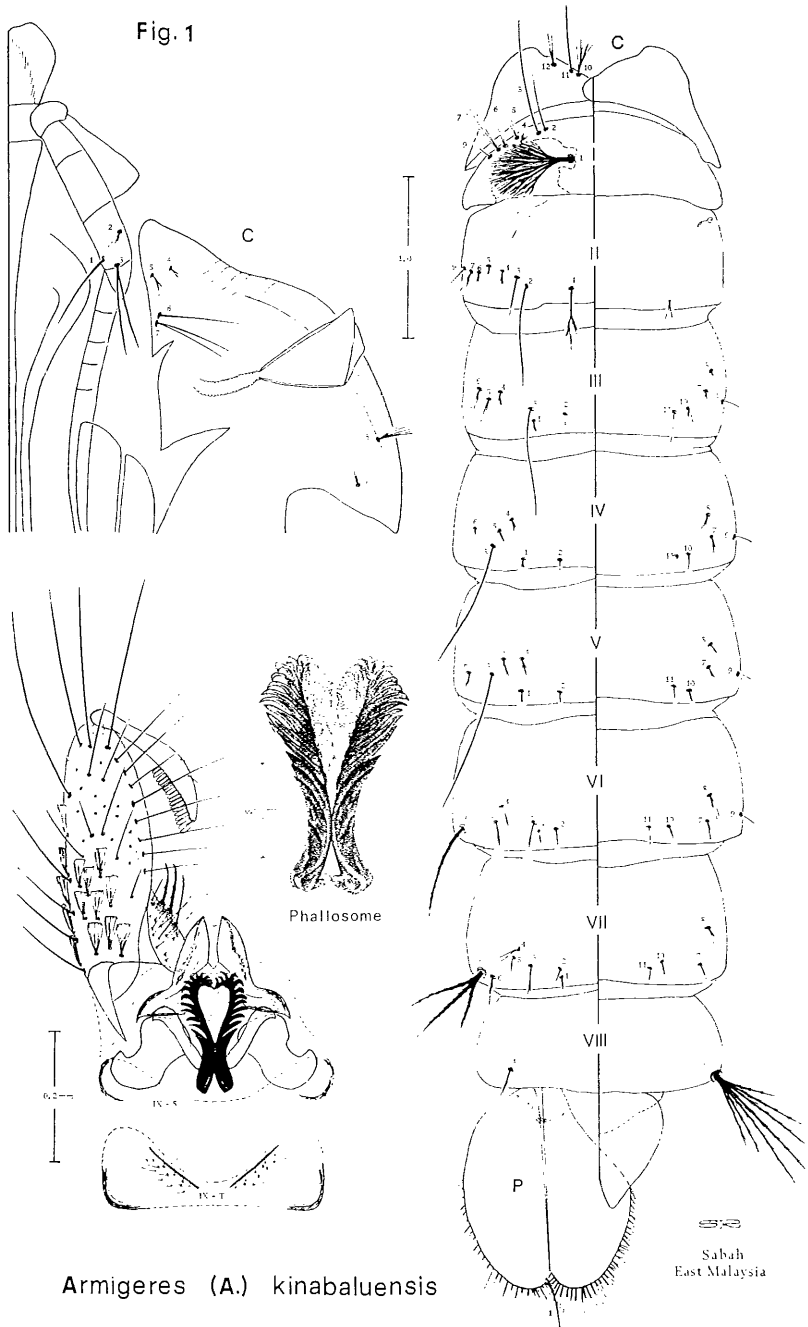
Wing: Dark Scaled. Cell R2 about  $1\frac{1}{2}$  times the length of its stem. Anal vein ending beyond fork of Cu. Alula and upper calypter with a row of hair like scales.

Haltere: Capitellum dark, rest light in colour.

Abdomen: Terga I to VII dark scaled on dorsal aspect with patches of white scales laterally; tergum VIII dark scaled, with a row of pale scales at the base. Scale pattern on abdominal sterna variable. Sternum II: mostly covered with white scales, but occasionally a few scattered dark scales are present. Sterna III to V: all white scaled (42%); or white scaled with two small to medium lateral patches of dark scales in the middle of the sternite (50%); or very occasionally with a central dark band (8%). Sternum VI: mostly white scales; occasionally a few scattered dark scales are present among the white scales and very occasionally an apical or subapical band of dark scales are present. Sternum VII: mostly dark scales with an apical or subapical band of pale scales (50%), speckled white and black (39%), or all white (11%).

MALE.—Wing, 4.14 mm. Proboscis, 2.42 mm. Palpi, 2.93 mm. Fore femur, 2.52 mm. Resembles the female except in the following characters: Head: Palp approximately 1.2 the length of the proboscis. Antenna: 2.06 mm long; strongly plumose; last two segments much elongated and annulated. Unguis of fore leg much larger than in female; one much larger than the other, each with a single tooth. Unguis of mid and hind legs similar to the female. Abdominal sternum II: mostly dark scaled with few scattered white scales or entirely white scaled. Sterna III and IV dark scaled with narrow, basal and apical bands of white scales. Sternum V: as in previous sternum; though occasionally the basal or apical white bands may be broad. Sternum VI: mostly white scaled with narrow basal and apical dark bands. Sternum VII: mostly dark scaled, though a few apical white scales may occasionally be present.

MALE TERMINALIA (Fig. 1).—As figured. Tergum IX deeply bifurcated by broad V-shaped suture; each lobe bearing a patch of fine hairs. Sternum IX: large and membranous, with narrow lateral and basal sclerotized bands; median patch of about 4 fine setae. Gonocoxites fairly long; well separated from each other sternally; lateral and ventral aspects with long setae and scales; dorsal aspect with short, fine setae. Basal mesal lobe with two stout and one narrower setae on prominent bases, setae directed upwards and towards gonocoxite. Gonostylus about  $\frac{2}{3}$  the length of the gonocoxite, not reaching basal mesal setae, outer margin convex, with 1–2 small preapical setae; comb of 18(14–21) spiniforms on inner apical aspect; the apical spiniforms very slightly larger than the basal ones; individual spiniforms flat, with bluntly rounded apices. Phallosome-aedeagus complex, ventrally with 2 to 4 basal teeth, occupying



*Armigeres (A.) kinabaluensis*

basal two-thirds, apical portion swollen with 7-9 long curved teeth pointing dorsally on each side. Paraproct well developed.

**PUPA** (Fig. 1).—Abdomen, 5.1 mm. Trumpet, 0.58 mm. Paddle, 1.0 mm. Integument yellow to light brown pigmentation. Chaetotaxy as figured; setae light to dark brown. Prominent setae marked with an asterisk (\*). Cephalothorax: yellow to light brown pigmentation. Trumpet: slightly darker pigmentation; length 0.58 mm. Seta 1\*(1), 2(4,2-5), 3\*(2,2-3), 4(4,3-5), 5(4,3-6), 6\*(1,1-2), 7(2,1-2), 8(5,3-7), 9(3,2-5), 10(6,4-8), 11\*(1), 12(3,2-5). Abdomen: first four abdominal segments and mesonotum light brown in colour, remaining abdominal segments yellow. Segment I: Seta 1 large, slightly longer than length of segment, with 3 to 11 main branches. Seta 2\*(1), 3\*(1), 4(7,4-10), 5(2,1-3), 6(3,2-7), 7(3,2-6), 9(1,1-2). Segment II: Seta 1\*(15,10-22), 2\*(1), 3\*(1), 4(5,3-9), 5(2,2-4), 6(3,2-5), 7(4,3-6), 9(1). Segment III: Seta 1(3,2-4), 2(1), 3\*(1), 4(4,1-4), 5(3,2-5), 6(3,2-4), 7(3,2-5), 8(3,2-5), 9(1), 10(3,2-4), 11(1,1-2). Segment IV: Seta 1(4,2-6), 2(1), 3\*(1), 4(4,2-7), 5(3,2-4), 6(3,2-4), 7(3,2-5), 8(3,2-4), 9(1), 10(2,2-3), 11(1,1-2). Segment V: Seta 1(3,2-5), 2(1), 3\*(1,1-2), 4(4,2-5), 5(4,2-6), 6(3,2-4), 7(4,4-7), 8(3,2-4), 9(1), 10(2,2-3), 11(1,1-2). Segment VI: Seta 1(2,1-4), 2(1), 3(2,2-4), 4(2,2-4), 5(3,2-4), 6\*(1), 7(2,2-3), 8(3,2-4), 9(1), 10(1,1-2), 11(2,1-2). Segment VII: Seta 1(2,1-3), 2(1), 3(3,2-3), 4(2,2-3), 5(2,1-4), 6(3,2-6), 7(2,1-3), 8(3,2-5), 9\*(3,1-5), 10(2,1-3), 11(1,1-2). Segment VIII: Seta 4(3,2-3), 9\*(7,5-9). Paddle: lightly pigmented, with strong midrib and long fringe. Hair 1 single, conspicuous. Male genital lobe extending to about 0.59 of paddle, female genital lobe to 0.3.

**LARVA** (Fig. 2).—Head, 0.87 mm. Siphon, 0.96 mm. Anal saddle, 0.33 mm. Chaetotaxy as figured, setae lightly to moderately pigmented. Stellate setae and spicules absent. Integument smooth. Prominent setae marked with an asterisk (\*).

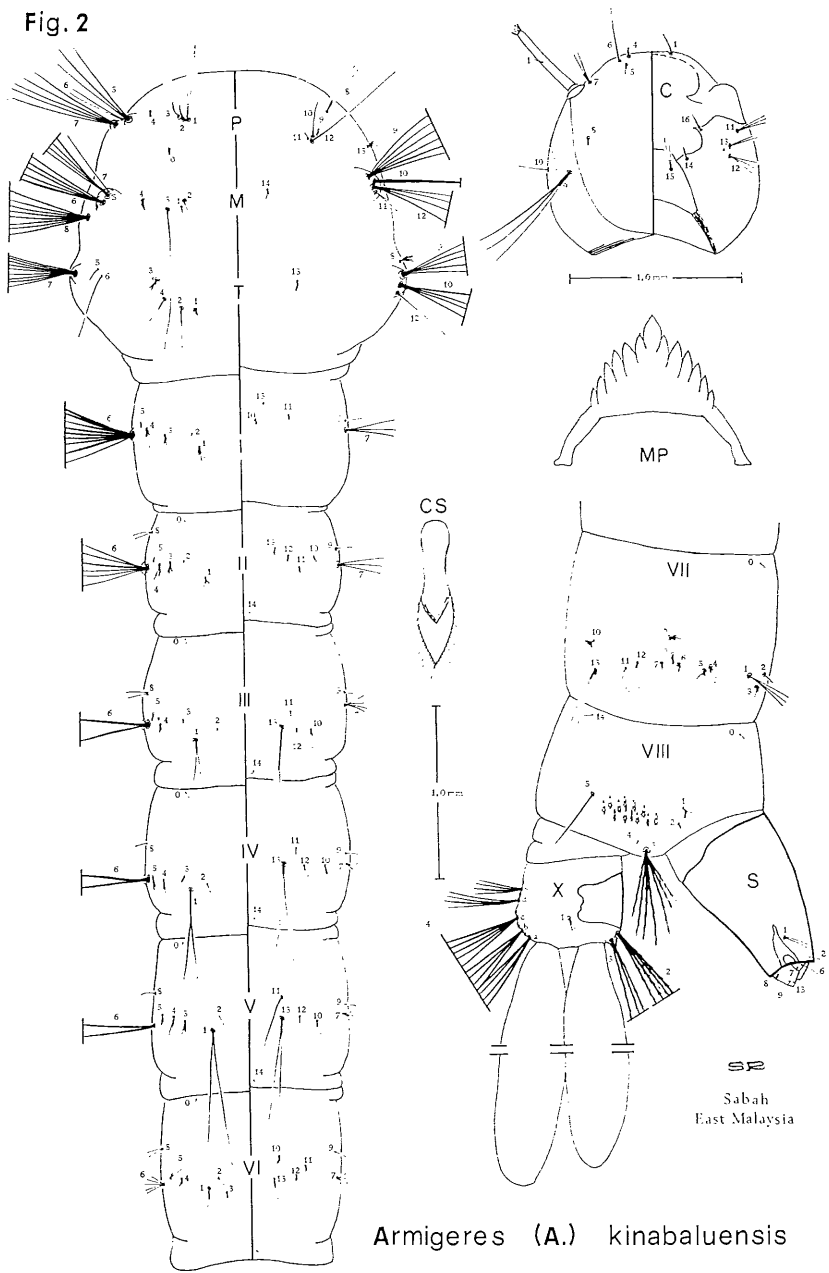
**Head:** Width about 1.07 of length. Ocular bulge not prominent; collar well marked. Pigmentation yellow-brown in colour except areas around mouth and collar which are slightly darker. Integument smooth. Mental plate with a strong median trilobed tooth and with 5(4-6) well developed teeth on each side. Seta 1(1, small tapering and curved inwards), 4(5,3-8), 5(3,2-4), 6(1), setae 4, 5 and 6 are well forward on the head, 7\*(3,2-3), 8(2,1-3), 9\*(3,2-3), 10(1,1-2), 11(2,1-3), 12(3,2-5), 14(2,1-3), 15(2,1-3), 16(1,1-2).

**Antenna:** Length about 0.28 of head. Shaft about same breadth from base of apex. Integument smooth; yellow in colour. All setae single. Seta 1 at 0.49 from base.

**Thorax:** Long and prominent setae with barbs. Setae 9, 10, 11 and 12 arising from common tubercle. Prothorax: Seta 0(5,3-6), 1\*(2,2-3), 2(1,1-2), 3(2,1-3), 4(4,3-6), 5\*(3,2-4), 6\*(2,1-3), 7\*(5,3-8), 8\*(3,2-5), 9(3,2-4), 10\*(1), 11(2,2-3), 12\*(1). Mesothorax: Seta 1(2,2-3), 2(1,1-2), 3\*(1,1-2), 4(5,3-6), 5\*(4,3-5), 6\*(5,3-7), 7\*(1,1-2), 8\*(8,6-12), 9\*(6,4-8), 10\*(1), 12\*(4,2-4), 13(5,4-7). Metathorax: Seta 1(3,2-4), 2\*(2,1-3), 3(5,3-9), 4(2,1-3), 5(1), 6(1), 7\*(8,7-11), 8(5,3-6), 9\*(5,4-6), 10\*(4,2-5), 12\*(2,1-3), 13(3,3-5).

**Abdomen:** Segment I: Seta 1(6,4-7), 2(1,1-3), 3(5,3-7), 4(5,3-7), 5(3,2-5), 6\*(9,6-11), 7\*(3,2-3), 9(2,1-3), 10(3,2-5), 11(3,2-5), 13(1,1-2). Segment II: Seta 1(4,3-5), 2(1,1-3), 3(5,3-7), 4(5,4-6), 5(2,2-3), 6\*(6,4-7),

Fig. 2



*Armigeres (A.) kinabaluensis*

7\*(3,2-4), 8(2,2-4), 9(1,1-2), 10(3,2-4), 11(3,2-4), 12(4,2-5), 13(4,3-6).  
 Segment III: Seta 1\*(2,1-4), 2(1,1-2), 3(2,2-3), 4(4,3-5), 5(3,1-4), 6\*(2,2-3), 7(4,2-4), 8(2,1-3), 9(1), 10(3,2-4), 11(2,2-3), 12(2,2-3), 13\*(2).  
 Segment IV: Seta 1\*(2,2-3), 2(1,1-2), 3(2,2-3), 4(3,2-5), 5(3,2-5), 6\*(2,1-2), 7(4,2-5), 8(1,1-3), 9(1), 10(3,2-4), 11(3,2-3), 12(2,1-3), 13\*(2,2-3).  
 Segment V: 1\*(2,1-3), 2(1,1-2), 3(5,4-6), 4(4,3-4), 5(3,2-5), 6\*(2,1-5), 7(4,2-5), 8(1,1-2), 9(1), 10(3,2-4), 11\*(1,1-2), 12(2,2-4), 13\*(2,2-4).  
 Segment VI: 1\*(2,1-3), 2(1), 3(3,1-5), 4(4,2-7), 5(4,2-6), 6(5,3-6), 7(4,3-4), 8(2,1-3), 9(1), 10(5,4-7), 11(3,2-3), 12(3,2-4), 13(2,1-3).  
 Segment VII: Seta 1\*(4,2-5), 2(1), 3\*(2,2-3), 4(4,3-4), 5(4,3-5), 6(6,4-7), 7(3), 8(8,5-12), 9(5,3-7), 10(7,5-9), 11(2,1-3), 12(3,1-3), 13(2,1-3).  
 Segment VIII: Seta 1(6,5-10), 2(2,2-4), 3\*(7,5-9), 4(2,1-3), 5\*(1). Comb scales 12(8-20) in one to three irregular rows; lightly pigmented and slipper shaped; fringe present on apical half. Siphon: short and stumpy; index 2.2 (1.7 to 2.5); pigmentation brown; pecten teeth absent; seta 1(2,1-2), arising about 0.26 from apical end of siphon), 2(1), 6(1), 7(1), 8(3,1-5), 9(1), 13(1). Anal Segment: Saddle: incomplete, only dorsal plate present; brown pigmented. Gills long, with rounded apices, ventral pair slightly longer than dorsal pair. Seta 1(4,2-5), 2\*(4,3-5), 3\*(3), 4a\*(4,3-4), 4b\*(4,3-5), 4c\*(5,3-7), 4d\*(4,3-7), 4e\*(3,3-6).

TYPE DATA.—Holotype male (S-1194.17), with slides of associated larval and pupal skins and genitalia, Mount Kinabalu, Sabah (North Borneo), East Malaysia, elevation 7,500 feet above sea level, from hole in fallen tree, in cloud forest, 6 June 1970, Samuel Wilson James (USNM). Allotype female (S-1194.32) with slide of associated larval and pupal skins, same data as holotype (USNM). Paratypes: 12 male, 19 female, 17 slides of associated larval and pupal skins, 8 slides whole larvae, all from the same collection (S-1194) as holotype. Four male, 2 with slides of associated skins (S-1194.11 and .22), 2 slides male genitalia; 8 female, 5 with slides of associated skins (S-1194.16, .18, .20, .23 and .24) and 3 whole larvae (USNM). Three males, 2 with slides of associated skins (S-1194.14 and .26), 1 slide male genitalia; 4 female, 2 with slides of associated skins (S-1194.21 and .30) and 2 whole larvae (BM). Five males, 3 with slides of associated skins (S-1194.13, .15 and .28), 2 slides of male genitalia; 7 females, 3 with slides of associated skins (S-1194.10, .25 and .27), and 3 whole larvae (Ramalingam).

SPECIMENS EXAMINED.—Total 225: 40 males, 61 females, 49 larvae; 59 individual larval rearings and 16 male genitalia slide preparations.

TAXONOMIC DISCUSSION.—The female of *kinabaluensis* can be distinguished from all other species of *Armigeres* (*Armigeres*) by a combination of the following characters: clypeus bare; mesonotum with a narrow border of pale scales and without distinct golden lines; presence of a single lower mesepimeral seta; fore coxae white scaled

with a dark patch in centre; hind femur with line of white scales on outer side, narrowing towards knee; sternite III-V all white scaled (42%) or with small, median, lateral patches of dark scales (50%), very occasionally with central dark band (8%); sternite VI mostly white scaled or with narrow line of apical or subapical dark scales; sternite VII dark scaled with apical or subapical white band (50%), speckled white and black (39%) or all white (11%). The male can be easily recognised by the very distinctive phallosome, the apical outer margin of which bears 7 to 9 long curved teeth on each side. There is an extensive range of variation in the colour pattern of the abdominal sterna, unlike that seen in other species of this subgenus. However, there is little doubt that this is a single species, as the whole range of variations, with intermediates, can be often seen within the same collection, without any corresponding changes in the male genitalia or in the immature stages.

A continuous narrow line of white scales around the mesonotum of *kinabaluensis*, associates it closely with *subalbatus*, *joloensis*, *confusus* and *giveni*. *Armigeres subalbatus* and *joloensis* have their abdominal sterna II to VI with white and black bands and resemble those specimens of *kinabaluensis* that occur at the end of the range of variations of abdominal sterna, where black and white bands are also present. However, the black bands in *kinabaluensis* occur in the center of the abdominal sterna and are flanked on both sides with white bands; whereas in *subalbatus* and *joloensis* they are apical in position. On the other end of the range of variations of abdominal markings in *kinabaluensis*, sterna II to VI may appear all white, in which case there is a close resemblance to *confusus* and *giveni*. Sternum VII in *confusus* and *giveni* is always fully dark scaled, whereas in *kinabaluensis*, sternum VII is either with a mixture of dark and white scales or dark scaled with an apical or subapical white band, but never fully dark scaled. Furthermore, the white line of scales on the outer aspect of the hind femora narrows towards the tip in *kinabaluensis*, but continues as a broad line to the knee in *confusus* and *giveni*.

DISTRIBUTION.—Sabah, EAST MALAYSIA: Collected from only two localities, Mount Kinabalu and Tambunan, both on the Crocker Range, and approximately 30 to 40 miles distant from each other. Not known elsewhere.

BIOLOGY.—*Armigeres kinabaluensis* appears to be restricted to higher elevations and all collections of this species were made in the cloud forest at elevation ranging from 3,900 to 7,500 feet. Nineteen collections of the immature stages were made, the majority (13) of these being from tree holes, a few (5) from artificial containers and a single collection from the pitcher plant *Nepenthes lowii*. Nothing is known of the adult biology.

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